

The Ohio State University
Campus as a Living Laboratory

RecycMe: The Ohio State University Recycling Phone Application

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Table of Contents

| | |
|---|-----------|
| Executive Summary..... | 3 |
| Introduction | 4 |
| Recycling Behaviors..... | 4 |
| Ohio State Sustainability..... | 5 |
| Background of Environmental Behavior Change..... | 7 |
| Development of a Mobile Application..... | 8 |
| RecycMe: “The Main Idea”..... | 9 |
| <i>Blueprints.....</i> | <i>10</i> |
| <i>Goals: Competition and Education.....</i> | <i>11</i> |
| <i>Prizes.....</i> | <i>12</i> |
| <i>RecycMe’s Application of Behavior Change.....</i> | <i>13</i> |
| Discussion..... | 14 |
| <i>Setbacks.....</i> | <i>14</i> |
| <i>Future of RecycMe.....</i> | <i>15</i> |
| Conclusion..... | 15 |
| Works Cited..... | 17 |

Tables and Figures

| | |
|---|-----------|
| Figure 1: OSU Trash Production..... | 6 |
| Figure 2: OSU Recycling..... | 6 |
| Figure 3 NEMCOG Fact Sheet: | 12 |
| Figure 4: Model of Responsible Environmental Behavior..... | 14 |

Executive Summary

The Ohio State University recognizes the need to promote sustainability and environmental education throughout the university. The university's large size, spirit, and objective of environmental sustainability create an excellent environment in which to implement changes. In June 2012, Ohio State developed the Integrated Energy and Environment Implementation Strategy. One of the goals is to divert 90 percent of campus materials from landfills by 2050, and Ohio State will need to create less waste and focus more on reusable and recyclable resources to achieve this goal. Research shows that the best way to create change is to increase education and spread awareness. These concepts can most effectively be reached through a recycling phone application that aims to increase recycling habits at Ohio State.

RecycMe is a smartphone application that aims to increase recycling within the Ohio State community through three main methods: education, incentives, and accessibility. Education will both increase the awareness about the benefits of recycling and will encourage students to recycle on and off campus. Incentives or prizes will be the base of competition among students and faculty. The prizes will help draw a larger body of students, which will spread the information more rapidly. Accessibility is key to the application's success. If the app is not easy to use, and if recycling is not available, then the application is pointless. Recycling needs to be made accessible and attractive to students. Increased accessibility will prevent students from throwing items in the trash or littering.

RecycMe will be used during a three-month competition that occurs twice a year. The purpose of the application is not to host a competition, but to educate the community through the competition. QR codes will be placed on recycling bins throughout the campus. These QR codes can be swiped by smartphone users, and they will provide an accessible link through the application that will instantly provide the user with information on the benefits of recycling. Additionally, the user will be able to set up a profile and gain points each time they recycle and swipe the QR code. In the long run, this program will encourage The Ohio State University community to recycle more, and will generate more excitement about sustainability on campus.

Introduction

Environmental education can help the public make informed decisions that are necessary to make large scale changes and shape the future of sustainability. This project lays the foundations for an environmental mobile phone application, which would be accessible to the Ohio State community. The Ohio State University recognizes the importance of waste divergence and sustainability on campus; it has become one of the leading universities for sustainability programs including the Zero Waste Program, Buckeye Footprint, and the Climate Action Plan. As part of the American College and University Presidents' Climate Commitment, OSU has committed to diverting 90% of waste by 2030. Our proposed phone application, RecycMe, aims to increase recycling at Ohio State through environmental education and competition. The application of RecycMe as a sustainability program will help push Ohio State to reach its goal of reducing waste and encourage the community to make long-term behavior changes. This paper will provide information about global recycling, technological development, and environmental behavior changes that support the construction of our phone application. Our research shows that providing individuals with valuable information about recycling encourages individuals to recycle more than they would have done with their previous knowledge base. The paper will outline the mobile application's use of QR codes to provide URL links for educating on recycling and sustainability, and prizes to provide incentives to use the mobile application. The following sections will discuss key aspects of the behaviors, technology and program needed to make RecycMe successful.

Recycling Behaviors

Recycling is an effective alternative to trash production and landfill buildup. Through the diversion of waste, recycling can be applied to consumers' everyday materials. Although it is an effective approach, there are certain criteria that affect people's recycling behaviors. An article by Ida Berger (1997), titled *The Demographics of Recycling and the Structure of Environmental Behavior*, examines the influence of socioeconomic and demographic variables on environmentally responsible behaviors. After compiling data from almost 45,000 households, the analyses concluded that the

size of residential area, type of dwelling, education, and income are all significant determinants of whether recycling facilities are available and used (Berger, 1997). In general, over 75% of waste is recyclable, but only about 30% of it is actually recycled (“11 Facts About Recycling”). On average, Americans generate 4.4 pounds of trash every day, which is equivalent to 1,600 pounds per year (“11 Facts About Recycling”). These results are important because they have direct implications for policy makers interested in encouraging recycling behaviors. The facilitators of recycling and composting programs should be provided indiscriminately, meaning the government should strive to provide equal access to environmental protection services, just like it does with access to healthcare and education (Berger, 1997).

Recycling is now more relevant than ever before. The ongoing degradation of the environment has already had negative social and economic consequences, and will continue that way unless it is stopped. At 7.1 billion people and counting, the world population continues to increase daily and people need to focus their efforts on being more sustainable and reducing waste. By recycling, humans can have a direct impact on their environment. When one recycles, he or she conserves scarce natural resources like oil, water, and trees. Energy is also conserved because it takes less energy to make new products from recycled materials than from virgin materials (“Buckeye Footprint”, 2012). Other positive impacts include reducing water and air pollution, and also reducing greenhouse gases (“Buckeye Footprint”, 2012). Recycling is an important aspect of urbanization in which people need to participate more. By recognizing this need, Ohio State has increased recycling in addition to other sustainability projects.

Ohio State Sustainability

Ohio State is continuously striving to be one of the leading universities in the nation, which is why OSU sets such high standards. Since 2004, the University has reduced its trash by 9%, and increased recycling by 110% (Fig.1 and Fig. 2; “Buckeye Footprint,” 2012). These statistics show that OSU is committed to making a difference by recycling and ultimately to improving the environment.

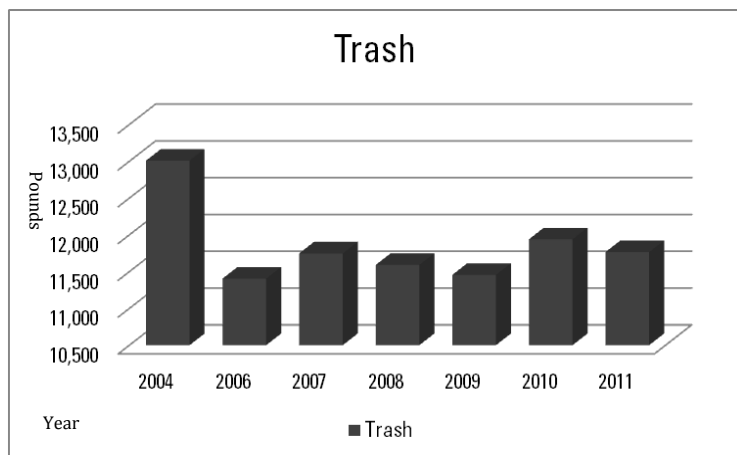


Figure 1: OSU's Trash Production from 2004 to 2011

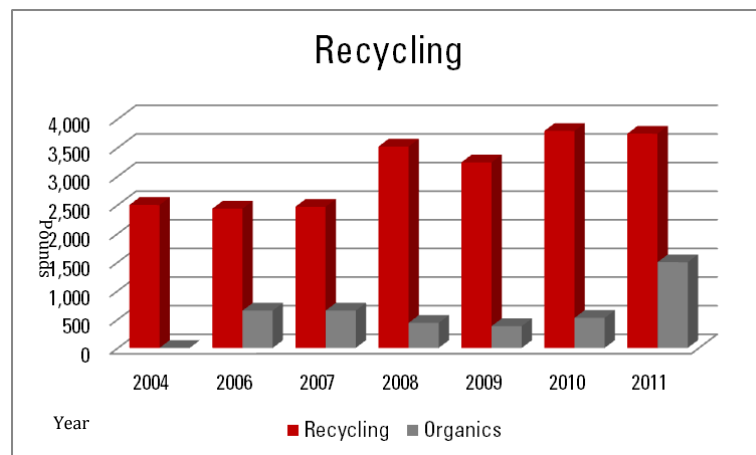


Figure 2: OSU's Recycling and Composting from 2004 to 2011

According to the OSU Sustainability website (2013), Zero Waste is defined as diverting 90% or more of OSU waste from landfills by recycling and composting. The Zero Waste Program, initiated at Ohio Stadium for the Buckeyes' 2012 football season, aims to improve alternatives to waste production. Items can be recycled or composted depending on the product. For example, Recyclable items include plastic and glass bottles and aluminum cans, while compostable items include food, napkins, paper products, and pizza boxes. The diversion rate from the Illinois game is one of the highest ever to be achieved at a sporting venue, with a rate of 98.2% ("OSU Sustainability", 2013). This rate is impressive, since Ohio Stadium is the largest stadium in the country to attempt Zero Waste.

Not only does Ohio State lead the Big Ten in stadium recycling, but OSU also ranks number 12 on the EPA's Top 20 University List of Green Power purchasers ("Buckeye Footprint", 2012). According to the Buckeye Footprint website, "Ohio State has purchased nearly 61 million kilowatt-hours (kWh) of renewable energy credits this year, which is enough power to meet ten percent of Ohio State's electricity usage needs. The amount of green credits generated will reduce Ohio State's carbon footprint by 43,000 metric tons of carbon dioxide, roughly the amount of emissions associated with the 56 million miles of university sponsored air travel ("Buckeye Footprint" 2012)".

The Zero Waste program and the purchase of renewable energy illustrate OSU's dedication to becoming more sustainable. OSU is making strides to reduce its impact on the environment. With the campus moving more toward Zero Waste, the phone application will push OSU the extra mile it needs to succeed. Through the use of this phone application, OSU can increase awareness of recycling across campus, which would result in another great achievement for OSU. Our team needed to understand how an individual's awareness of environmental issues could affect that individual's positive behavior towards the environment, and then decide how to apply those insights to our mobile phone application

Background of Environmental Behavior Change

The decision to create our interactive phone application was based on how individuals make behavioral choices about the environment, or nature. First, it is important to recognize that people hold different views of nature, which can range from an emotional affinity towards nature, to indifference, and even to disregard. Either way, an individual's emotional affinity towards nature, or lack thereof, partly shapes the reasons that an individual engages or disengages in "nature protective behavior" (Kals, 1999). Second, both knowledge and attitude play a key role in predicting environmental behaviors (Levine and Strube, 2012). The more knowledgeable an individual is about environmental issues, the more likely he or she is to engage in pro-environmental behaviors. A study completed by the National Environmental Education and Training Foundation found that Americans' knowledge about the environment is minimal; however, those who were knowledgeable were participating more in environmentally friendly behaviors (Levine and Strube, 2012).

Knowledge can promote environmentally friendly behaviors in two ways: intentionally through increased awareness of one's actions, and automatically through a developed habit (Levine and Strube, 2012). It is crucial that environmental education creates long-term changes in individuals' environmental behaviors by increasing mindfulness towards the environment. It is not sufficient to provide only knowledge of an issue-it is also important to provide procedural knowledge, or "knowledge of action" ("Annex: Behaviour Change Models"). Positive changes in behavior towards the

environment can be made through the use innovative technologies: in our team's case, the development of a mobile application that encourages users to recycle.

Development of a Mobile Application

It was crucial for the team to understand the basic development process of a mobile application in order to create RecycMe. A mobile application is defined as, “a software application designed to run on smartphones, tablet computers and other mobile devices (Tracy, 2012).” Mobile applications are made and used for a wide variety of everyday needs. Examples include the weather, time, photos, account finances, and cooking recipes. More advanced mobile applications may also include interactive games, and voice or face-to-face communication.

A mobile application, like all software, begins with coding. There are many different programming languages for coding: some examples include HTML, Javascript, C, C++, CSS, and Java. Each programming language has similarities and differences with other programming languages, and the selection of which programming language to use depends upon which can best provide what is needed for the specific mobile application desired within a company's financial constraints and marketing preferences. For example, Android uses Java, C, and C++ program languages, while Windows Mobile uses C and C++ (Holzer and Ondrus, 54). A simple mobile application uses far fewer lines of code than a more complex application does. A small application, like a standard calculator, is less than 10,000 lines, while a large application ranges between 50,000 and 2 million lines (“What Are Examples Small/medium and Large Applications?” 2013).

The development process varies according to coding size, number of developers, and complexity of the project. Although the development process can take up to 18 weeks to complete, the typical development time is four to twelve weeks (“How Long Does it Take to Make a Business Mobile Application”). The cost of making a mobile application varies depending on its size and function. A small application costs \$3,000 to \$5,000, while a large and complex application costs \$50,000 or more to produce. A survey of 96 mobile app developers showed the average cost to develop an app was \$6,453, (Patel, 2010).

Today, mobile applications are used more than ever before. In 2010, the International Data Corporation (IDC) counted 300,000 available applications that were downloaded 10.9 billion times. The IDC predicts that global application downloads will reach 76.9 billion by 2014 (Ellison and Shirer, 2010). Major organizations and corporations are finding mobile applications a convenient way to communicate with their constituencies. For example, the Environmental Protection Agency is increasingly recognizing the need to promote environmental technology. The EPA website's page, "My Green Apps", is solely dedicated to helping the public find existing green applications (EPA, 2012). Four core reasons explain why mobile applications are increasingly being used by consumers and most large mobile device brands like Apple, Android, Blackberry, and Nokia. These reasons are: (1) instant retrieval and communications via a high speed data network; (2) relative cheapness and speed due to high performing devices with large memory capabilities; (3) user friendly markets for obtaining mobile applications and for encouraging third party developers to create and publish mobile applications; and (4) low barriers to entry (Tracy, 2012).

Increasing mobile application use has led to more research on the progressive functions of mobile apps. The opportunity to create smartphone applications directed towards sustainability is growing as smartphone technology is also advancing. By taking advantage of new technology, "effective mobile applications will result in observable, measurable, and direct behaviors and consequences (Pitt et al., 2011)." RecycMe will be a new mobile application that can be a leader in environmental education and sustainability. With a basic understanding of the creation of mobile applications discussed in this section, our team formulated the framework for RecycMe, which is presented in the following section

RecycMe: The Main Idea

RecycMe will be a phone application with an objective to positively influence sustainability at Ohio State. Once the team conceived the idea behind RecycMe, the team conferred with Corey Hawkey and Niffy Ovuori of OSU's Office of Sustainability. After meeting with them, it was clear that a plan was needed to interactively engage students about Ohio State sustainability. The RecycMe phone application combines the

rapid use of modern smartphone technology with OSU campus recycling behavior. Although the primary goal of the application is to increase recycling for OSU community members, a secondary, and equally important goal of the application is to spread information about recycling and its potential positive impact on the environment. RecycMe will be used in a competition format that will run twice a year: once during autumn semester, and again during spring semester.

To make RecycMe as accessible as possible, it should be associated with OSU Mobile. OSU Mobile, which launched in 2011, provides quick, mobile access to Ohio State resources including student grades and class schedules (OSU Mobile, 2011). In addition to allowing users to easily create a profile with their OSU username and password, this joint application will enable RecycMe to be developed faster and less expensively than a new platform.

There are three possible options to create the application. The first is having the Digital Union, which specializes in technological help, assist in the creation of RecycMe. Second, OSU students could create the application through grants or a capstone course, which could provide hands-on experience to students who are interested in technology. Third, the creators of OSU Mobile could also assist in RecycMe's creation, which could be funded by grants. Depending on the possible creators, the application could be maintained by interns of either the Information Technology department or by the Office of Sustainability at Ohio State. The following section delineates design specifics for the proper execution of RecycMe

Blueprints

The design of the app will include a user profile and a QR code scanner. Each user profile will be modeled similarly to the Foursquare application, where app users have both a friends section and a statistics section, and can learn which destinations are most visited. The statistics section will display the user's personal recycling history and their point value. This way, the users can see their past recycling history and current recycling behaviors, and make decisions on future personal recycling goals and earning competition points. The QR code scanner on mobile phones will link users to sites providing information on recycling, goal setting, and a landfill impact picture, which

will be discussed more fully in the following section. QR codes are free code generators, which, when scanned, provide URL links, information posts or photos to the user's mobile phone (Boise State University, 2013). Also, users will be able to make their own posts to a newsfeed section, making the app more personal by enabling interactivity and the sharing of ideas with other Ohio State community members.

More specifically, QR codes will be placed on many of the on-campus recycling bins during each of the three-month competition periods and will be unique to each recycling bin. After a user scans a QR code with a mobile phone, the user's phone will receive information on recycling, additional websites of interest, and a point awarded to the users' profile. Awarded point totals will be posted on the statistics page for all to view in order to help stimulate friendly competition and greater awareness and interest in recycling.

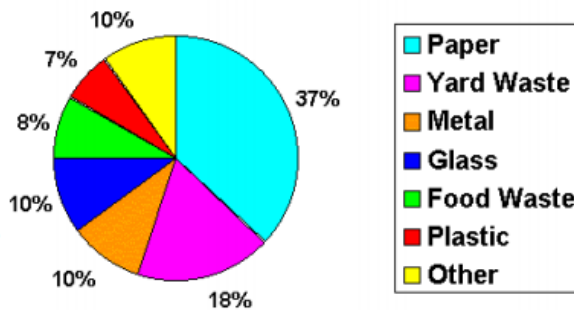
Goals: Education and Competition

The QR code linked informational posts discussed in the previous section will include facts about OSU and global recycling practices, habits and goals. Most QR codes will lead users to websites that are filled with information on recycling, not just a simple fact or two, in order to encourage positive sustainability behavior from the user. One good information example is the Northeast Michigan Council of Governments' Recycling Fact Sheet PDF that provides both visuals and data on why people should recycle (Figure 3). Another is what should and should not be recycled and the necessary condition an object must be in before being recycled. An informational fact that could convey the problem of waste to the user in a powerful manner is that "the highest point in Ohio is Mount Rumpke, which is actually a mountain of trash at the Rumpke sanitary landfill!" (Northeast Michigan Council of Governments).

Trash and Landfills

- Although 75% of our trash can be recycled, the EPA set a national goal of 25% for 1992. * Every year, each American throws out about 1,200 pounds of organic garbage that can be composted.
- New Jersey has the highest recycling rate of all the states--56%!
- The U.S. is the #1 trash-producing country in the world at 1,609 pounds per person per year. This means that 5% of the world's people generate 40% of the world's waste.
- This chart shows the composition of an average garbage dump. Notice how much of it is recyclable!!
- The highest point in Ohio is "Mount Rumpke," which is actually a mountain of

Composition Of An Average Dump



3

Figure 3: Northeast Michigan Council of Governments Recycling Fact Sheet PDF

Although the educational information will give RecycMe users clear reasons to recycle, and hopefully, to modify long-term behavior towards recycling and environmental protection, the competition twice a year will help to get users involved and make them feel a part of something larger than themselves. Both students and faculty will be eligible for the competitions. The news feed and profile information showing point totals for all participants should help to stimulate interest in the competition as they strive for prizes.

Prizes

The top three recyclers after each three-month competition will win a prize based on the accumulation of points. If multiple winners have the same number of points, there will be a lottery drawing for three top winners; however, if possible, everyone will receive a small prize. The sponsors of the prizes should be affiliated with Ohio State in order to make prizes not only inexpensive, but also as attractive as possible to OSU community members. The sponsorship will benefit the university in two ways: contribution to OSU sustainability programs creates good publicity, and it also increases advertising for the sponsors. Ohio State will be able to claim that their businesses are environmentally

friendly. Businesses will also gain advertisement, which will be displayed near the QR swipe locations and within the information sheets themselves. A few companies that could sponsor RecycMe include SBX Books, Wired Out, and D-Tix. Possible additional prizes could be from local Columbus businesses, like Short North clothing stores and restaurants. The three grand prizes and those for the top ten percent of recyclers could include items like tickets to sporting events (Blue Jackets or Columbus Crew) and concerts, discount-book vouchers, gift cards, and relatively inexpensive electronic devices. Depending on the number of winners, smaller prizes for all participants could be T-shirts or reusable water bottles and bags.

RecycMe's Application of Behavior Change

As previously mentioned, RecycMe will use fact sheets to promote education about recycling. These fact sheets are key to creating a behavior change on campus because every time students and faculty use the application, they are gaining knowledge about recycling. This new knowledge about recycling reinforces an individual's intention to act on responsible environmental behaviors. In 2009, a study at Michigan State University found that information about recycling and recycling programs both influenced and encouraged recycling behavior on campus. (Kaplowitz et al., 2009). The study further found that both students and faculty would like to learn more about how to recycle and recycling benefits (Kaplowitz et al., 2009). A person's personality and knowledge affect their intention to act (Figure 4). By adding a situational factor like the competition aspect, RecycMe has an increased probability of producing responsible environmental behaviors.

Although RecycMe is a unique idea to Ohio State, it is not the first recycling application to use QR codes to promote recycling. A similar successful application was created in Whangarei, New Zealand, last year. That campaign, called, "It's a Karma Thing", also used QR codes to promote and encourage people to recycle. Several permanent recycle bins were set up in key locations while the project ran from October 22 to December 16, 2012. When someone recycled and scanned the QR code on their bottle, they would then get "Karma Credits", which were used on their Karma website to bid for prizes. According to their website, Love NZ has helped recycle over 200 tons of

packaging and organic waste in December 2012, which was over a 60 % increase from the previous year (“Karma is King”, 2013). This is a huge increase in recycling, which proves that incentives help to promote recycling. Examining the Love NZ program, gave our team confidence that behavior changes can be made through competition. By viewing this example, we can see where a program like this could have potential downfalls, which brings us to our next topic of setbacks.

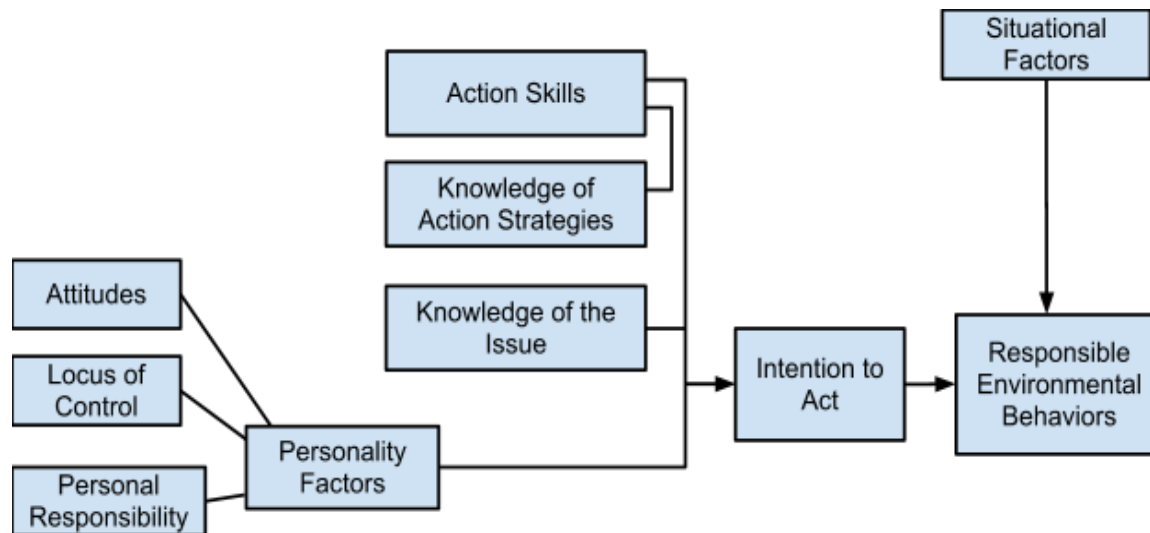


Figure 3: Hungerford, et al. (1987) proposed model of responsible environmental behaviors

Discussion

Setbacks

Most new endeavors encounter some setbacks and require adjustments. The team has considered what some difficulties experienced by RecycMe might be and formulated potential responses. Sustainability decision makers could have concerns about the competition potentially resulting in excessive recycling during competition periods and virtually no recycling at other times. However, a friendly competition is actually an effective way to motivate a large campus to recycle because it ultimately unites peers to achieve a common goal. Peers draw people into social movements; creating RecycMe as a mobile application that is interactive is an effective tool to

influence other community members to become involved. Although the competition will only run once each semester, it can make an impact on recycling throughout the year. The educational information provided each time a user recycles will promote good recycling habits that are applied year round. One way to address potential excessive recycling during competition periods is to limit the number of times a person can use the application and scan recycling bins. This limitation will help to eliminate excessive recycling, and ensure that people would use the application not necessarily to win, but more importantly to gain information and form good habits.

Future of RecycMe

RecycMe will be Ohio State's first recycling application. It will be the foundation for green apps to be implemented at OSU. If RecycMe is successful on the Columbus campus, the team would like eventually to expand the application to both off campus and branch campuses as well. RecycMe will require resources and time to create, but the dollar costs will be small compared to other sustainability projects at OSU. Additionally, RecycMe has the potential to have benefits that far outweigh its monetary costs. If the application is created correctly, the opportunities are endless. The application will hopefully increase recycling on and off OSU's campus, and eventually may become a Big Ten competition. A Big Ten competition could generate environmental awareness among hundreds of thousands of students, as well as create significant OSU and Big Ten spirit. RecycMe can make a huge impact on OSU's recycling commitment and an even bigger statement across college campuses.

Conclusion

For the RecycMe mobile phone application to be successful, it needs to be unique, generate excitement around recycling, and form habits that will endure. Our team incorporated our research findings about the path between knowledge and environmental behavior change and used these research findings to create an environmental educational tool that will interactively engage the university community. The core idea for the creation of this phone application is to spread awareness, educate, and provide an incentive to recycle. RecycMe aims to tackle the vast amount

of waste that Ohio State produces while simultaneously educating students. It will reduce OSU's footprint further by complementing other sustainability initiatives that are already being implemented to tackle waste production.

Ohio State's recent commitment to sustainability provides a perfect opportunity for our mobile application to thrive. RecycMe integrates both the expanding technological and environmental movements, which will make the application more appealing to a broader audience. The use of QR codes not only provides instant accessibility to recycling information, but also facilitates competition by awarding points. By utilizing humans' natural competitiveness and biophilic fondness, the application will be a bridge between the growing technological universe and society's interaction with the environment. The information from research on current successful mobile phone applications, Ohio State's sustainability plans, and communities' behavioral changes towards nature all strongly suggest that RecycMe can be a foundation for beneficial changes in recycling habits of the OSU community.

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